Draft Report

DIESEL PARTICULATE MATTER MITIGATION PLAN FOR THE BNSF RAILROAD SAN DIEGO RAIL YARD

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February 12, 2009

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1. INTRODUCTION

In accordance with the 2005 California Air Resources Board (CARB)/Railroad Statewide Agreement (MOU), BNSF has prepared this Mitigation Plan for the San Diego Rail Yard. The purpose of this Plan is to outline the potential mitigation measures that can be used reduce Diesel particulate matter (DPM) emissions from the San Diego Rail Yard. The Plan also contains sections detailing how the baseline and projected emissions were calculated and mechanisms that will be used to track progress. The baseline emissions were described in great detail in a series of reports that are publicly available (http://www.arb.ca.gov/railyard/hra/hra.htm).

As discussed below, the proposed Mitigation Measures, when fully implemented, will reduce the DPM emissions from the San Diego Yard by 63% from 2005 baseline. These emission reductions will concurrently lower any existing predicted health risk associated with the facility operations. Other federal, state, and local air pollution control measures and plans, and existing railroad voluntary agreement measures will supplement the current and future emission reduction discussed in this Plan.

2. SUMMARY OF RAIL YARD OPERATIONS

The San Diego yard is a smaller BNSF operated rail yard in the vicinity of San Diego harbor. Its north-west to south-east configuration is framed by the East Harbor Drive, Switzer Street, Terminal Street, Crosby Road and Cesar E. Chavez Parkway. The administration building, as well as the street entrance to the yard, is located in the south-west corner at Cesar E. Chavez Parkway. It should be noted that several other industrial activities appear within the mentioned street boundaries.

The main purpose of the San Diego yard is to make-up trains. Making up trains is the break-up of arriving trains into rail wagons (representing a collection of cars or a piece of a train) and the compiling of rail wagons to complete trains for departure.

The rail cars are moved within the yard by switching locomotives. The switchers operate on both ends of the rail yard and partially outside the yard's boundaries. The center of the yard is used mainly for rail car parking. Ready trains will leave the yard north-eastward. Two trains are made-up in San Diego per day. One more train is passing through the yard per day, meaning that no change to the rail car configuration is being made. Three trains arrive in the San Diego yard per day.

The movement of rail cars and assembly of trains is the only significant activity at the San Diego site. No cargo handling operation occurs within the San Diego yard. The rail cars are loaded and unloaded elsewhere. Prior to 2005, the BNSF rail yard included a loading facility for autos. The activity, which occupied half of the yard area, is no longer in service. The tracks and facilities are leased to third parties.

The main rail line for through traffic runs north-east of East Harbor Drive and thus separated from the BNSF yard. Therefore, traffic on those tracks was not included in the yard's inventory.

3. EMISSIONS SUMMARY

Tables 3-1 and 3-2 below, shows the DPM emissions from the San Diego Yard, by equipment category, for the 2005 baseline year, and for future years as the mitigation measures proposed in this Plan are implemented over time. As shown in Table 3-1 and 3-2, when the proposed mitigation measures are implemented DPM emissions will be reduced by approximately 68 percent without considering activity growth. These emission reductions will concurrently lower any existing predicted health risk related to facility operations. A detailed discussion of each mitigation measure is provided in Section 6.

The projected emission reduction calculations shown in Table 3-1 and 3-2 do not assume a gradual increase in freight handled at the San Diego Yard, but estimates with activity growth are provided in Section 4. The assumptions and methodologies used to predict the rate of growth are discussed in Section 5. In addition, the analysis takes into account certain other future regulatory measures and voluntary agreements, which will be implemented and effective by 2020.

In summary the emission totals for all rail yards were compiled using the adjustments to the emission inventory projecting fleet turnover and future year emission rates. The totals, by source category, are provided in Tables 3-1 and 3-2 for San Diego.

Table 3-1. Estimated total annual DPM emissions associated with the operations at the San Diego facility with 2005 activity levels. (metric tonnes)

San Diego	**PM Emissions (metric tonnes)**			
Facility Operations	**2005**	**2010**	**2015**	**2020**
Basic Services	0.00	0.00	0.00	0.00
Switching	0.15	0.11	0.06	0.06
Arriving and Departing Trains	1.33	1.19	0.72	0.41
On-Road Fleet Vehicle	0.00	0.00	0.00	0.00
Other Off-Road TRU	0.02	0.01	0.00	0.00
Other Off-Road Track Maintenance	0.01	0.01	0.01	0.01
Total	**1.51**	**1.32**	**0.79**	**0.48**

Table 3-2. Estimated total annual DPM emissions associated with the operations at the San Diego facility with 2005 activity levels. (short tons)

San Diego	**PM Emissions (short tons)**			
Facility Operations	**2005**	**2010**	**2015**	**2020**
Basic Services	0.00	0.00	0.00	0.00
Switching	0.17	0.12	0.07	0.07
Arriving and Departing Trains	1.47	1.31	0.79	0.45
On-Road Fleet Vehicle	0.00	0.00	0.00	0.00
Other Off-Road TRU	0.02	0.01	0.00	0.00
Other Off-Road Track Maintenance	0.01	0.01	0.01	0.01
Total	**1.66**	**1.46**	**0.87**	**0.53**

4. EMISSION INVENTORY METHODOLOGY

In forecasting emissions at rail yards, ENVIRON projected the impact of several rulemakings and voluntary initiatives. These rulemakings and initiatives include emission reductions expected to result from Federal, State, and voluntary emission reduction strategies from all sources. The emission reductions will primarily result from normal and accelerated fleet turnover to engines meeting more stringent new engine emission standards. Normal fleet turnover is the fleet replacement expected due to retirement of older equipment for mechanical or other business reasons. Accelerated turnover of equipment is the centerpiece of many California rulemakings and some voluntary initiatives and is expected to result in emission reductions in years immediately after a change in the new engine emission standards. Retrofit of older equipment is often available as an alternative element to comply with accelerated turnover.

The emission sources affected include the following source categories:

- Locomotives (Line-Haul & Switching)
- Heavy Equipment (truck and off-road equipment)
- Transport Refrigeration Units (TRU) and Refrigerated Railcars
- Other Miscellaneous Diesel-Fueled Equipment

The emissions consider a constant 2005 level of activity and apply activity changes after the fact. Overall ENVIRON expects emissions from rail yards to have significant reductions in the years 2005 through 2020 as a result of Federal, State, and local initiatives affecting new engines and of replacement or retrofit of older equipment with engines and equipment using low emission technology. The projected emission reductions without considering growth range from 13% in 2010 to 68% in 2020, and adding the expected growth results in emission reductions from 8% in 2010 to 63% in 2020. A no growth scenario was run to determine the emission reduction due to fleet turnover or other measures prior to applying any growth estimate. The growth estimates for this yard were estimated at 1%. The no growth and growth scenarios are shown in Table 4-1 and in Figures 4-1 and 4-2 for San Diego rail yard.

Table 4-1. DPM emission (short tons per year) forecast summary for BNSF San Diego.

Yard (condition)	2005	2010	2015	2020
No growth	**1.66**	**1.46**	**0.87**	**0.53**
With growth	**1.66**	**1.53**	**0.96**	**0.61**

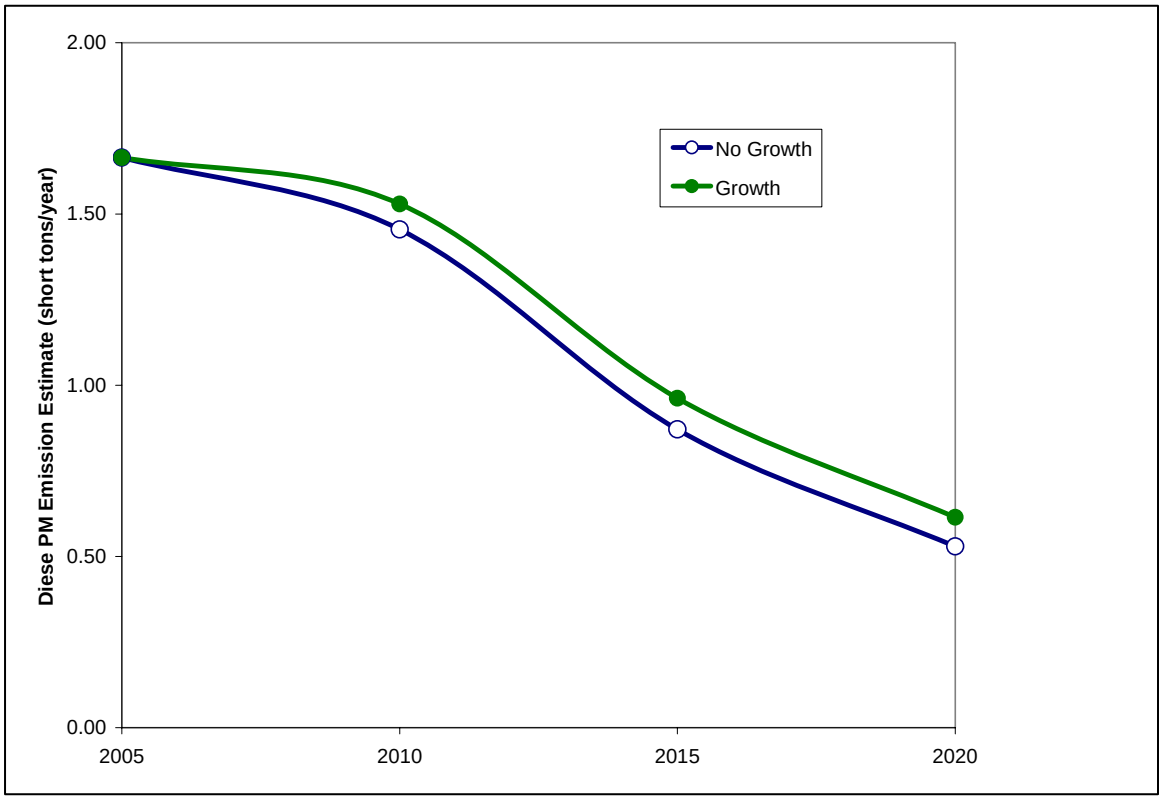

Figure 4-1. BNSF San Diego emission summary (with and without growth) in short tons.

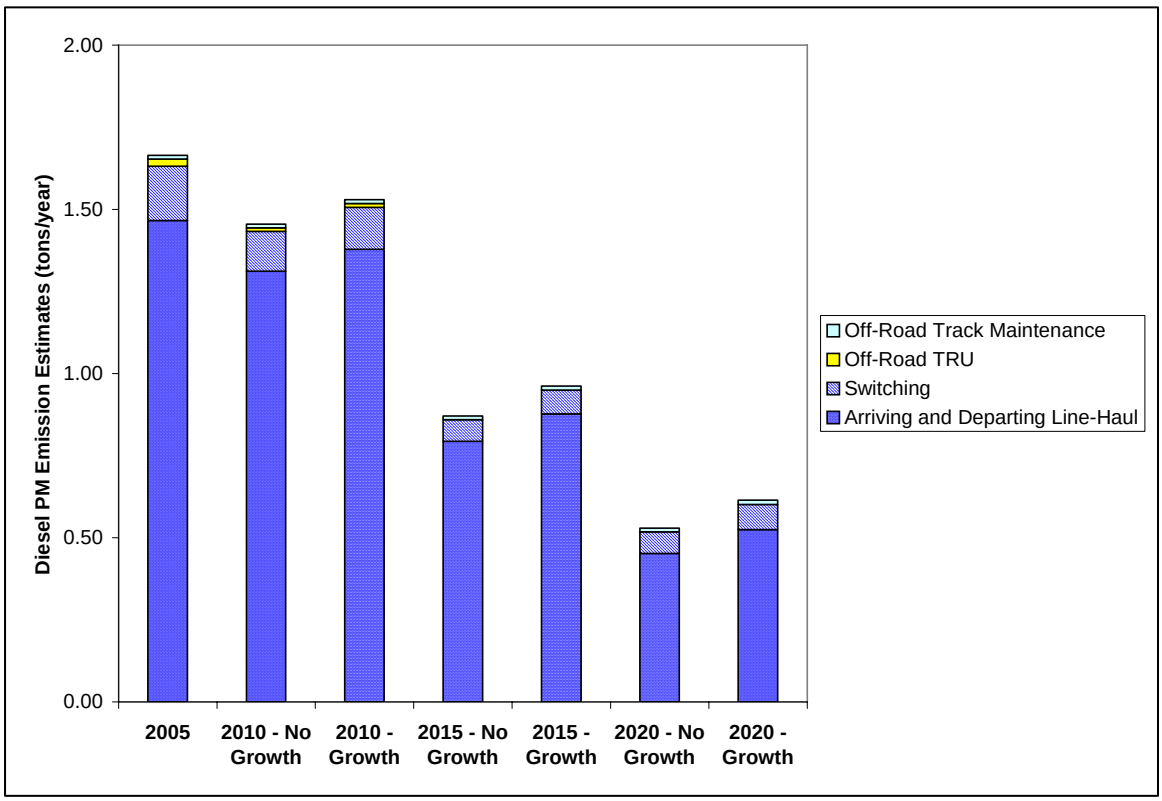

Figure 4-2. BNSF San Diego emission summary (with and without growth) by source category in short tons.

A general discussion of the analytical methodology and assumptions used to calculate the 2005 baseline emissions and to forecast emissions for calendar years 2010 through 2020, for each equipment category is provided below. Detailed emission calculations for the 2005 baseline year can be found in the San Diego Toxic Air Contaminants Emissions Inventory with modifications for the revised emission inventory methods described in this report.

4.1 Locomotives

In addition, BNSF has agreed in the MOU (ARB/Railroad Statewide Agreement, "Particulate Emission Reduction Program at California Rail Yards," June 2005) to reduce idling and to use lower sulfur fuels for locomotives based and refueled in California.

The reduced idling agreement calls for locomotives based in California to be refit with idle shut-off devices, limiting each idle event to no more than 15 minutes. This will affect all switching locomotives at California yards and many line-haul locomotives. ENVIRON assumed that all BNSF new locomotives are fitted with idle shutoff; so at least all Tier 2 locomotives were expected to use these devices.

BNSF agreed to accelerate the use of low sulfur fuel in California ahead of the Federal standard for 15 ppm sulfur starting in 2012. By agreement, BNSF will use 15 ppm sulfur in 80% of the California refueling gallons with the remaining assumed to be at the 2007 Federal standard of 500 ppm. Based on an assessment of the in-bound locomotives using Federal fuel and out-bound locomotives using California fuel along with refueling rates at locations inside and outside of California, ENVIRON calculated the average sulfur level to be no higher than 0.034% in 2007-2011 time frame compared with 0.105% in 2005 due to the agreement.

EPA announced final emission standards (EPA, 2008) that include an analysis of the expected benefit of normal fleet turnover and the additional benefit of the EPA rule. The emission standards include a retrofit of existing equipment as well as new locomotive emission standards. Existing Tier 0, 1, and 2 locomotives will be subject to retrofit at the time of rebuild; so the locomotives will be rebuilt gradually throughout their remaining useful life.

The emissions standards and projected EPA emission factors are shown in Tables 4-2 and 4-3, depending on the duty cycle chosen to certify the locomotives - either line-haul or switching locomotive duty cycles. The duty cycle for line-haul locomotives typically leads to lower emission on a gram per horsepower-hour (hp-hr) basis because the switching locomotive duty cycle has a considerable idling time (no hp-hr generated). In some cases the uncontrolled emissions are much lower than some of the emission standards, so no emission reduction would be expected from those standards especially for HC and CO emissions. The relative emission factors provided by EPA were used to adjust the locomotive emission rates. For instance, for the Tier 2 remanufactured locomotives the PM emissions were reduced by 55.6% that reflect the expected emission reduction from 0.08 g/hp-hr for remanufactured locomotives compared to 0.18 g/hp-hr for the baseline Tier 2 locomotives in Table 4-2b.

Table 4-2a. Locomotive – Emission standards (g/hp-hr) for line-haul (duty cycle) locomotives.

Emission Standard	Applicable Year	HC (g/hp-hr)	CO (g/hp-hr)	NOx (g/hp-hr)	PM (g/hp-hr)
Uncontrolled Emissions	**Pre-1973**	**0.48**	**1.28**	**13.0**	**0.32**
Tier 0 – original	1973 – 2001	1.00	5.0	9.5	0.60
Tier 0 – final[1]	2008 / 2010	1.00	5.0	8.0	0.22
Tier 1 – original	2002 – 2004	0.55	2.2	7.4	0.45
Tier 1 – final[1]	2008 / 2010	0.55	5.0	7.4	0.22
Tier 2 – original	2005	0.30	1.5	5.5	0.20
Tier 2 – final[1]	2013	0.30	1.5	5.5	0.10
Tier 3	2012 – 2014	0.30	1.5	5.5	0.10
Tier 4 [2]	2015	0.14	1.5	1.3	0.03

[1] These are retrofit standards at the time of rebuild and phased in as retrofit kit availability.
[2] The Tier 4 NOx standard can be a 1.4 NOx + HC standard.

Table 4-2b. Locomotive – EPA projected emissions factors (g/hp-hr) for line-haul locomotives.

Locomotive Type	Applicable Year	HC (g/hp-hr)	CO (g/hp-hr)	NOx (g/hp-hr)	PM (g/hp-hr)
Uncontrolled Emissions	**Pre-1973**	**0.48**	**1.28**	**13.0**	**0.32**
Tier 0 – original	1973 – 2001	0.48	1.28	8.60	0.32
Tier 0 – final[1]	2008 / 2010	0.30	1.28	7.20	0.20
Tier 1 – original	2002 – 2004	0.47	1.28	6.70	0.32
Tier 1 – final[1]	2008 / 2010	0.29	1.28	6.70	0.20
Tier 2 – original	2005	0.26	1.28	4.95	0.18
Tier 2 – final[1]	2008 / 2013	0.13	1.28	4.95	0.08
Tier 3	2012 – 2014	0.13	1.28	4.95	0.08
Tier 4 [2]	2015	0.04	1.28	1.00	0.015

[1] These are estimated emissions with retrofit with some exceptions for older Tier 0 locomotives.
[2] The Tier 4 NOx standard would not apply until 2017, while the other standards would apply starting in 2015. The Tier 4 NOx standard would apply, however, at remanufacture for model year 2015 and 2016 locomotives.

Table 4-3a. Locomotive – Emission standards for switching (duty cycle) locomotives.

Emission Standard	Applicable Year	HC (g/hp-hr)	CO (g/hp-hr)	NOx (g/hp-hr)	PM (g/hp-hr)
Uncontrolled Emissions	**Pre-1973**	**1.01**	**1.83**	**17.4**	**0.44**
Tier 0 – original	1973 – 2001	2.10	8.0	14.00	0.72
Tier 0 – final[1]	2008 / 2010	2.10	8.0	11.80	0.26
Tier 1 – original	2002 – 2004	1.20	2.5	11.00	0.54
Tier 1 – final[1]	2008 / 2010	1.20	2.5	11.00	0.26
Tier 2 – original	2005	0.60	2.4	8.10	0.24
Tier 2 – final[1]	2008 / 2013	0.60	2.4	8.10	0.13
Tier 3	2011 - 2015	0.60	2.4	5.00	0.10
Tier 4 [2]	2015	0.14	2.4	1.30	0.03

1 These are retrofit standards at the time of rebuild and phased in as retrofit kit availability allows.
2 The Tier 4 NOx standard can be a 1.3 NOx + HC standard.

Table 4-3b. Locomotive – EPA projected emission factors for switching (duty cycle) locomotives.

Locomotive Type	Applicable Year	HC (g/hp-hr)	CO (g/hp-hr)	NOx (g/hp-hr)	PM (g/hp-hr)
Uncontrolled Emissions	**Pre-1973**	**1.01**	**1.83**	**17.4**	**0.44**
Tier 0 – original	1973 – 2001	1.01	1.83	14.0	0.44
Tier 0 – final[1]	2008 / 2010	0.57	1.83	10.62	0.23
Tier 1 – original	2002 – 2004	1.01	1.83	9.9	0.43
Tier 1 – final[1]	2008 / 2010	0.57	1.83	9.9	0.23
Tier 2 – original	2005	0.51	1.83	7.3	0.19
Tier 2 – final[1]	2008 / 2013	0.26	1.83	7.3	0.11
Tier 3	2011 - 2015	0.26	1.83	5.4	0.08
Tier 4 [2]	2015	0.08	1.83	1.00	0.015

1 These are estimated emissions with retrofit with some exceptions for older Tier 0 locomotives.
2 The Tier 4 NOx standard would not apply until 2017, while the other standards would apply starting in 2015. The Tier 4 NOx standard would apply, however, at remanufacture for model year 2015 and 2016 locomotives.

4.1.1 Line-haul Locomotives

Line-haul locomotives are responsible for long-haul trips that enter classification yard pulling arriving and departing trains (TA/TD).

The fleet composition is an important consideration in the forecasted emissions. For 2010, 2015 and 2020, ENVIRON estimated the fleet turnover to Tier 2 (through 2011), Tier 3 (through 2014) and Tier 4 locomotives to be 3% per year with the equivalent fleet replacement of Tier 0, Tier 1, and Tier 2 locomotives by the Tier 3 and Tier 4 locomotives. ENVIRON assumed that the Tier 3 and 4 locomotives percentage emissions reductions would occur equivalently for all modes (idle and notches) from the Tier 2 locomotives. The Tier 3 PM emission standard is essentially the same as the rebuilt Tier 2, but the locomotives meeting Tier 4 standards have a lower PM emission standard.

This assumption of the fleet make-up somewhat overstates future year emissions because Dash 9 and the ES44 Tier 2 locomotives have higher rated power than some of the locomotives used in 2005. Therefore either fewer locomotives or lower power notch settings would be used to perform the same work with these higher powered locomotives.

BNSF estimated that the remaining Tier 0 and Tier 1 locomotives would undergo locomotive rebuilds every 6 years or 17% of the fleet per year. Likewise because Tier 2 locomotives would be rebuilt every 8 years, 12.5% of the Tier 2 fleet would be rebuilt per year. The final rebuild kits would be available for all locomotives starting in 2010 for Tier 0 and Tier 1, and 2013 for Tier 2. Some emission reductions could occur earlier, but ENVIRON chose to ignore the phase-in period for rebuild kits assuming no kits would be available prior to the mandated date. The emission reduction was calculated to be 37.5% for Tier 0 and 1 rebuilds (0.20 g/hp-hr compared to the baseline PM emission rate of 0.32 g/hp-hr) and 50% for Tier 2 rebuilds from Tier 2 base emissions (0.20 to 0.10 g/hp-hr PM emission rate reduction).

Table 4-4 provides expected fleet composition with introduction of the Tier 3 and Tier 4 locomotives replacing the in-use fleet. ENVIRON assumes that the introduction of Tier 3 and 4 locomotives could replace the fleet of Tier 0 / 1 / 2 locomotives in equal proportion and so the fleet fraction of remaining Tier 0, 1, and 2 locomotives were proportionally reduced.

Table 4-4. Fleet composition estimate of locomotives at San Diego in future years.

Locomotive	Tier	2005	2010	2015	2020
Switchers	x	7.97%	2.44%	0%	0%
GP-3x	x	5.89%	1.80%	0%	0%
GP-4x	x	7.56%	2.31%	0%	0%
GP-50	x	0.10%	0.03%	0%	0%
GP-60	x	0.07%	0.02%	0%	0%
GP-60	0	5.89%	5.89%	5.89%	0%
Dash 8	0	12.11%	12.11%	3.71%	0%
Dash 9	0	38.60%	38.60%	6.43%	0%
Dash 9	0 – rebuild	0%	0%	32.17%	33.20%
Dash 9	1	15.81%	15.81%	2.64%	
Dash 9	1 – rebuild	0%	0%	13.18%	15.81%
ES44	2	5.99%	20.99%	17.99%	3.00%
ES44	2 – rebuild	0%	0%	6.00%	20.99%
ES44	3	0%	0%	9.00%	9.00%
ES44	4	0%	0%	3.00%	18.00%
Total		**100%**	**100%**	**100%**	**100%**

Idle emission reductions are difficult to predict. Past locomotive idle times were found to be short and result from main line congestion and speed limits forcing engineers to back off power, but no idle emission reductions are expected for this activity category. The TA/TD locomotives however do spend more time in the yard where locomotives can idle a significant amount of time. ENVIRON assumed that the idle shut-off devices would reduce TA/TD locomotives idle time to 1 hour (15 minutes for each event; arrival and train cut out, move to refueling area, arrival at ready track awaiting assignment, and prior to leaving with a new train) per arrival of new Tier 2 locomotives with factory installed idle limiting timers.

4.1.2 Switching Locomotives

Based on conversation with BNSF, the switching locomotives will continue to be Tier 0 compliant and remanufactured according to the schedule that EPA has finalized. The emissions for switching locomotives will be affected by the MOU idle reduction measure in addition to the remanufacturing emissions reductions. It will take a study to determine the idle reduction due to idle shut off devices installed on these locomotives. Because some emission reduction will be realized with these devices, ENVIRON assumed a 30% reduction of the time in idle mode.

4.1.3 Locomotive Service

Some locomotives (primarily line-haul) arriving at San Diego are refueled on site from fuel delivery trucks. In 2005 roughly 200 trucks serviced about 1,000 locomotives of the approximately 5,000 arriving at San Diego. ENVIRON assumed the service activity to be affected by the idle reduction devices on Tier 2 and later locomotives reducing the idle time from 1.5 hours to 0.5 hours accounting for up to two moves of the locomotive at the service site.

4.2 On-road Vehicles

Locomotives are refueled on site from tanker trucks driving into the yard. These trucks by and large are a minor source category accounting for about 200 truck trips in 2005 of about 1 mile driving distance each resulting in an insignificant portion of the yard emissions. The tanker trucks will be largely controlled through fleet turnover though the emissions were small in 2005.

Other on-road vehicle fleets based at the site are used by BNSF and contractor staff for crew changes, errands, and other general uses. The vehicle types are nearly all gasoline-fueled vehicles. The vehicle mileage on site for these vehicles is a very small portion of the vehicle's annual mileage and therefore results in little emissions in 2005. To estimate the emission reduction in future years, the EMFAC model was run to determine the expected emission reduction percentage using the default age distribution and fleet turnover in the county. For light-heavy duty diesel trucks, the minimum emission reduction that occurs from normal fleet turnover is 11% for 2005 to 2010, about 21% to 2015, and 24% to 2020.

4.3 Transport Refrigeration Units (TRUs) and Refrigerated Railcars (Reefers)

Transport refrigeration units (TRU) use small diesel generators to run refrigeration compressors on containers and refrigerated boxcars. By far more emissions are derived from containers than from boxcars in general. BNSF submitted emission estimates for its sites using the time on site of loaded containers and boxcar, however later it was realized that the engines running the refrigeration compressors only run 60% of the time on average. BNSF and ENVIRON conducted a survey of several dozen TRU units and compared the hours the TRU was working to the engine hours, both read from individual hour meters on each unit. Because ENVIRON overestimated the on-site TRU diesel generator engine emissions, the total emissions were adjusted downward for this analysis prior to assessing future year emissions.

ARB has written a rulemaking to address TRU emissions (2003). From this rulemaking, ARB estimated TRU emission reductions. 2005 BNSF TRU PM emission estimates were projected to 2010, 2015, 2020 based on emission factor reduction estimates that were drawn from the 2003 TRU ATCM ISOR, Figure VII-2 (ARB, ATCM ISOR, Figure VII-2, October 2003 http://www.arb.ca.gov/regact/trude03/trude03.htm). The emission reduction control factors are shown in Table 4-5.

Table 4-5. ENVIRON estimated ARB PM emission reductions for TRU.

Year	<25 HP	25-50HP	Combined
2000 to 2010	-18%	-70%	-66%
2010 to 2020	-28%	-91%	-79%

For each site, future year activity and population were assumed to be equivalent to 2005 activity and population. ENVIRON estimated the emission reduction for TRU for the years 2010, 2015 (through interpolation), and 2020.

4.4 Other Miscellaneous Diesel-Fueled Equipment

Other offroad equipment primarily consists of track maintenance equipment with portable engines occasionally used for general industrial purposes. Track maintenance equipment is comprised of any number of various equipment types from small pumps and generators to larger, specially designed equipment for rail line maintenance. However, equipment based at each site is used over the entire rail network, so a low fraction of this equipment activity and emissions occur on site.

To estimate emission reductions from this equipment, an OFFROAD model run using construction and industrial equipment was made to determine the relative emission reduction. The emission reduction equipment with rated power of 50 – 500 hp (the breadth of the equipment found at rail yards) are typically similar even though the standards and phase-in schedules for new emission standards vary by engine power. ENVIRON estimated the average emission reduction for 2010 at 14%, 2015 at 36%, and 2020 at 59%.

5. PROJECTED GROWTH RATES

Historic activity data from calendar years 1999 through 2008 were reviewed to determine the expected activity growth rate for the San Diego Yard. Table 5-1 summarized the historic activity data for the San Diego Yard.

Table 5-1. Historic Activity Data for Diesel-Fueled Equipment San Diego Rail Yard.

Activity	Historic Actual Data				Growth Rate (%)
	2005	2006	2007	2008	
Locomotive Arrivals	N/A	3,524	NA	3,278	Little Trend Data Available

As shown in Table 5-1, there is little historic activity data at the San Diego Yard, and what data is available shows a drop in activity from 2006 (the year used to represent 2005 activity) and 2008. Therefore, a 1% per year growth was assumed for the future year forecasts.

6. MITIGATION MEASURES

6.1 Current Mitigation Measures

BNSF has implemented all measures in the MOU with the state and works to comply with all rules as quickly as possible.

6.2 Proposed Future Mitigation Measures

BNSF will work with local and state authorities to investigate additional mitigation measures.

7. EVALUATION OF ADDITIONAL MITIGATION MEASURES

The evaluation of the current and proposed mitigation measures will be conducted once the mitigation measures have been specifically defined.

8. MECHANISMS FOR TRACKING PROGRESS

BNSF will work with state officials to determine a method for tracking the emissions reductions achieved through the implementation of the Mitigation Measures.

9. CONCLUSIONS

The emissions at the San Diego yard will be reduced by at least 60% by 2020 without considering any additional mitigation measures.